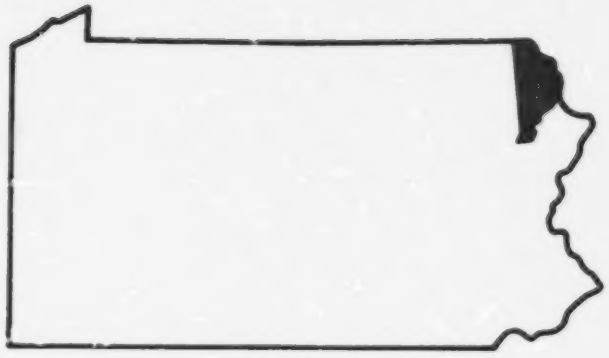
MAY 16 1988

FEM 1 209: 422158

FLOOD INSURANCE STUDY

TOWNSHIP OF BERLIN, PENNSYLVANIA
WAYNE COUNTY



JULY 15, 1988

COMPLETED

Federal Emergency Management Agency

COMMUNITY NUMBER - 422158

ORIGINAL

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

TABLE OF CONTENTS

1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	4
	2.4 Flood Protection Measures	4
3.0	ENGINEERING METHODS	4
	3.1 Hydrologic Analyses	5
	3.2 Hydraulic Analyses	6
4.0	FLOODPLAIN MANAGEMENT APPLICATIONS	8
	4.1 Floodplain Boundaries	8
	4.2 Floodways	8
5.0	INSURANCE APPLICATIONS	11
6.0	FLOOD INSURANCE RATE MAP	12
7.0	OTHER STUDIES	12
8.0	LOCATION OF DATA	13
9.0	BIBLIOGRAPHY AND REFERENCES	13

TABLE OF CONTENTS - continued

FIGURES

Figure 1 - Vicinity Map 3

Figure 2 - Floodway Schematic 9

TABLES

Table 1 - Summary of Discharges 5

Table 2 - Regulatory Data 7

Table 3 - Floodway Data 10

EXHIBITS

Exhibit 1 - Flood Profiles
Delaware River Panel 01P
Indian Orchard Brook Panels 02P-03P

Exhibit 2 - Flood Insurance Rate Map Index and Street Index
Flood Insurance Rate Map

Exhibit 3 - Elevation Reference Marks

FLOOD INSURANCE STUDY
TOWNSHIP OF BERLIN, WAYNE COUNTY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Berlin, Wayne County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for Indian Orchard Brook were prepared by the Philadelphia District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 16. The hydrologic and hydraulic analyses for the Delaware River were prepared by the U. S. Geological Survey (USGS) during the preparation of the Flood Insurance Study for the Town of Tusten, New York. The work for this study was completed in April 1987.

1.3 Coordination

An initial Consultation and Coordination Officer's (CCO) meeting was held in December 1984 with representatives of FEMA and the township to identify the streams to be studied by detailed methods. A search for basic data was made at all levels of government. Maps were obtained from the community and the USGS. On September 1, 1987, a final CCO meeting was held with representatives of FEMA, the township, and the COE (the study contractor) to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Berlin, Wayne County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods: the Delaware River, for its entire length within the community; and Indian Orchard Brook, from the downstream corporate limits to a point approximately 0.91 mile upstream. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through April 1992.

The following flooding sources were studied by approximate methods: Holbert Creek, Beach Lake Creek, Masthope Creek, Peggy Run, Rattlesnake Creek, Beach Lake, Chestnut Lake, South Branch Calkins Creek, Williams Pond, Open Woods Pond, Perkins Pond, and the remaining portions of Indian Orchard Brook. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Berlin.

2.2 Community Description

The Township of Berlin is located in Wayne County, covering an area of approximately 25,000 acres. It is bordered by the Townships of Oregon and Damascus to the north; the Town of Tusten, New York, and the unincorporated areas of Pike County to the east; the Township of Palmyra to the south; and the Borough of Honesdale, and the Townships of Dyberry and Texas to the west. Berlin had a population of 1,676 in 1980 and has a forecasted population of 1,801 for the year 2000 (Reference 1).

The first settlement in the Township of Berlin occurred around 1800 and was located at Smith Hill near the township's western corporate limits. In November 1826, Berlin was formed from part of the Township of Dyberry.

The topography of the area is characterized by numerous hills, lakes, and ponds, as well as several swamp areas. The Township is drained by many small streams of which Indian Orchard Brook is the most significant. Indian Orchard Brook flows in a southern direction just west of State Route 652. The steepest terrain within the township lies along the far northeastern boundary where the Delaware River separates Pennsylvania from New York. A 1986 land use summary indicates that the zoning for the township is predominantly residential, agricultural, and recreational.

BEST COPY AVAILABLE

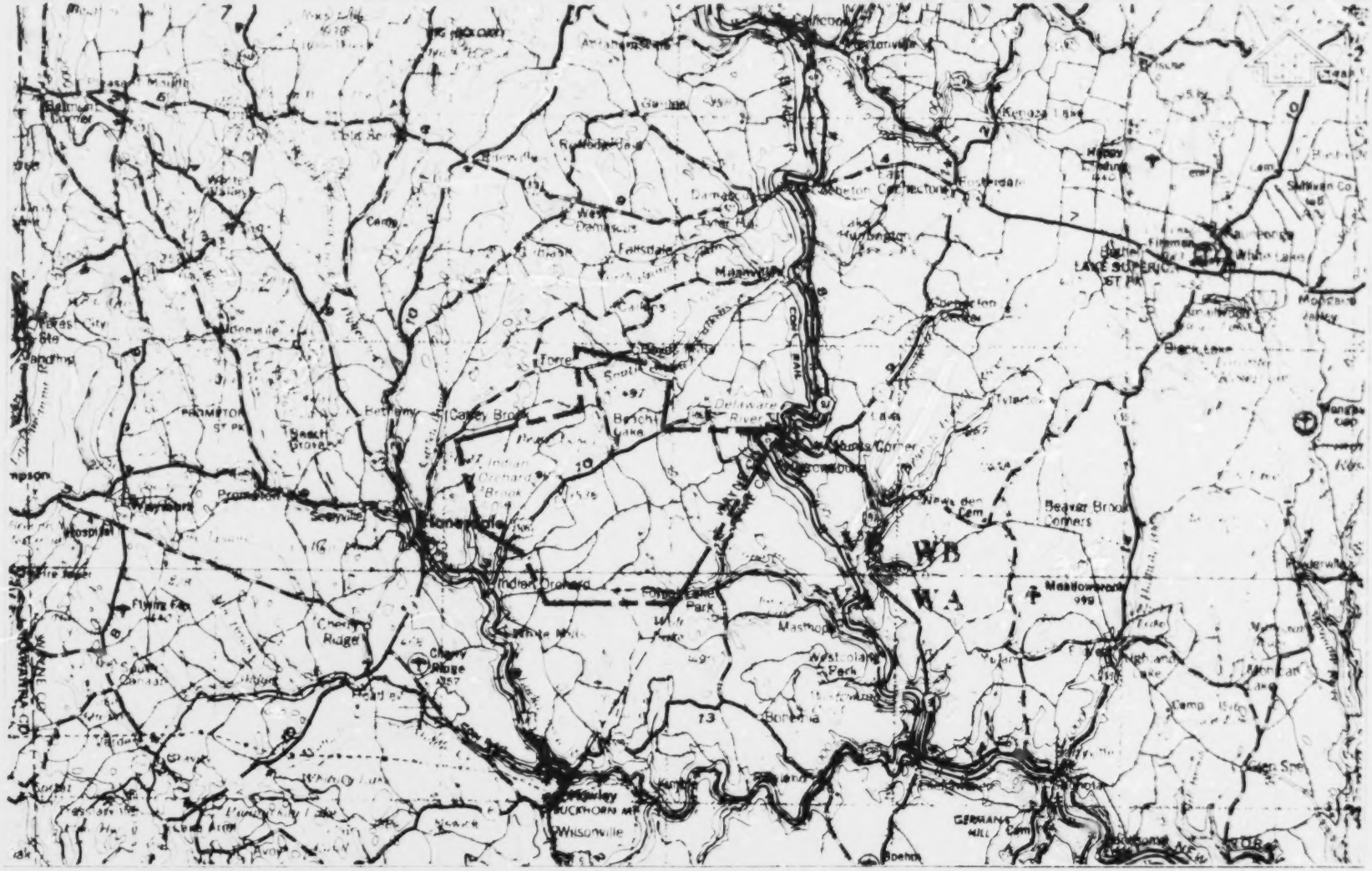


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BERLIN, PA

(WAYNE CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

The climate in this geographic area is characterized by temperatures ranging from an average high of 68 degrees Fahrenheit (°F) in summer to an average low of 30°F in winter. The average annual rainfall for the region is 44 inches.

2.3 Principal Flood Problems

The principal flood problems in the Township of Berlin are associated with the Delaware River and Indian Orchard Brook. A review of newspaper accounts reveals that little information concerning flood damage within the township is available. Severe flooding occurred in May 1942 and August 1955; however, extensive physical damage and loss of life in the surrounding area overshadowed flooding on streams within the township.

2.4 Flood Protection Measures

New York City has several water-supply reservoirs in the Delaware River basin. These reservoirs significantly retard floodwaters along the Delaware River even though they were not originally intended as flood control structures. The Cannonsville Reservoir near Cannonsville, New York, and the Pepacton Reservoir near Downsville, New York, are two New York City reservoirs that have helped reduce flooding along the Delaware River since their construction in 1963 and 1964, respectively.

There are no local flood protection measures on any of the other streams within the Township of Berlin. Residents of the community depend on the usual warnings issued through radio, television, and local newspapers for information concerning possible flood conditions. Flood warnings and predicted flood peaks are issued by the National Oceanic and Atmospheric Administration Flood Forecasting Centers located at Harrisburg, Pennsylvania, and Trenton, New Jersey.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk

of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The hydrologic analysis for the Delaware River was obtained from the Flood Insurance Study for the Town of Tusten, New York (Reference 2).

All USGS stream gages with a reasonable number of years of record in Monroe, Wayne, Pike, and nearby counties were analyzed. The methodology described in Bulletin 17B was used to develop 100-year discharges for Indian Orchard Brook (Reference 3). A regional curve showing drainage area versus 100-year flood discharge was then generated using the results of the statistical analysis. Data from this curve were applied to Indian Orchard Brook.

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGE (cfs) 100-YEAR
DELAWARE RIVER		
At USGS gage at Port Jervis (No. 01434000)	3,076	170,000*
At USGS gage near Barryville (No. 01428500)	2,025	150,000*
INDIAN ORCHARD BROOK		
At downstream limit of detailed study	6.0	866
Downstream of Private Road bridge	3.3	480

*Regulated annual peak discharge from the Delaware River Basin Commission Hydrology Coordinating Committee

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analysis for the streams studied by detailed methods were photogrammetric and/or field surveyed and were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures (Reference 4). The ground control for the photogrammetry was acquired using inertial surveying techniques (Reference 5).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations for the Delaware River were obtained from the Flood Insurance Study for the Town of Tusten, New York (Reference 2). Water-surface elevations of floods of the selected recurrence intervals for Indian Orchard Brook were computed using the COE HEC-2 step-backwater computer program (Reference 6). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. The starting water-surface elevation for the Delaware River was determined using a rating curve for USGS gage No. 01428500 near Barryville. The starting water-surface elevation for Indian Orchard Brook was obtained from the Flood Insurance Study for the Township of Texas (Reference 7). The results of the water-surface elevations for Indian Orchard Brook are tabulated for selected cross sections (Table 2).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the stream and floodplain areas (Reference 8). For the Delaware River, the channel "n" values ranged from 0.034 to 0.037, and the overbank "n" values ranged from 0.040 to 0.120. The roughness values for Indian Orchard Brook ranged from 0.045 in the main channel to 0.090 in the overbank area.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
A	<00	<0	390	0.9	<30	<10	1.1	<0	10	0.0	901.3
B	1320	15	420	0.4	<00	410	<.0	10	40	<.3	991.0
C	3000	10	<20	0.4	10	40	<.0	<30	<30	<.4	1020.3

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Township of Berlin
Wayne County
Pennsylvania

REGULATORY DATA

Indian Orchard Brook

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the streams studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 9).

For the flooding sources studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for the Township of Berlin (Reference 10).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

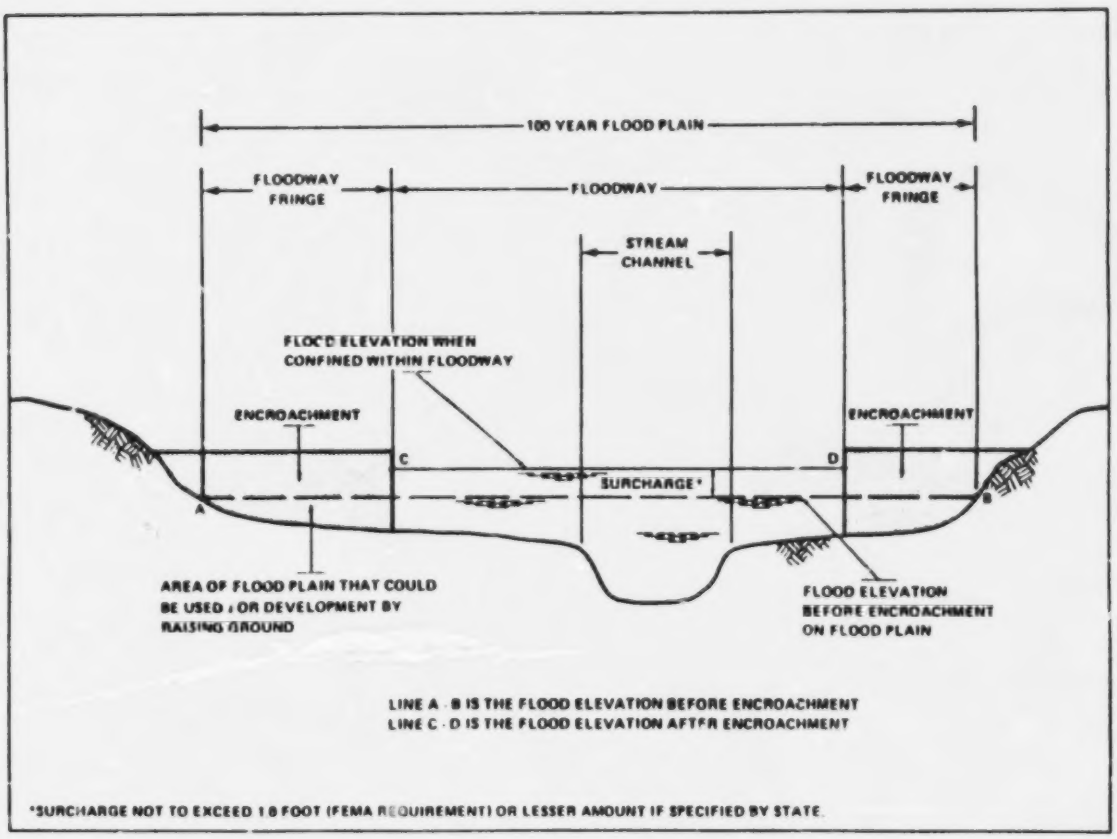
Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side

of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 3). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

No floodways were calculated as part of this study; the floodway for the Delaware River was obtained from the Flood Insurance Study for the Town of Tusten, New York (Reference 2). Portions of the floodway widths for the Delaware River extend beyond the corporate limits.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

BEST COPY AVAILABLE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FLET NGVD)			
Delaware River								
A	420	724	16,312	8.7	694.2	694.2	694.5	0.3
B	950	644	14,759	9.6	694.4	694.4	694.8	0.4
C	2,120	631	13,188	10.8	695.4	695.4	695.7	0.3

[1]Feet above limit of detailed study
[2]This width extends beyond corporate limits

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BERLIN, PA
(WAYNE CO.)

FLOODWAY DATA

DELAWARE RIVER

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain,and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Town of Tusten, New York; and the Township of Texas (References 2 and 7). The results of this study are in complete agreement with the results of those studies.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Berlin (Reference 10).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Pennsylvania, Washington, D. C., U. S. Government Printing Office, 1981.

2. Federal Emergency Management Agency, Flood Insurance Study, Town of Tusten, Sullivan County, New York, Washington, D. C., February 19, 1987.

3. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

4. Aerial Data Reduction Associates, Inc., of Pennsauken, New Jersey, Aerial Photogrammetric and Field Surveys of Monroe, Wayne and Pike Counties, Pennsylvania, September 1985 to January 1986.

5. Nortech Surveys (U.S.A.) Inc., Report on the Federal Emergency Management Agency Project, Inertial Elevation Survey For United States Army Corps of Engineers For Aerial Data Reduction Associates Inc., October/November 1985.

6. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, 1982.

7. Federal Emergency Management Agency, Flood Insurance Study, Township of Texas, Wayne County, Pennsylvania, Washington, D. C., September 30, 1987.

8. Ven Te Chow, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

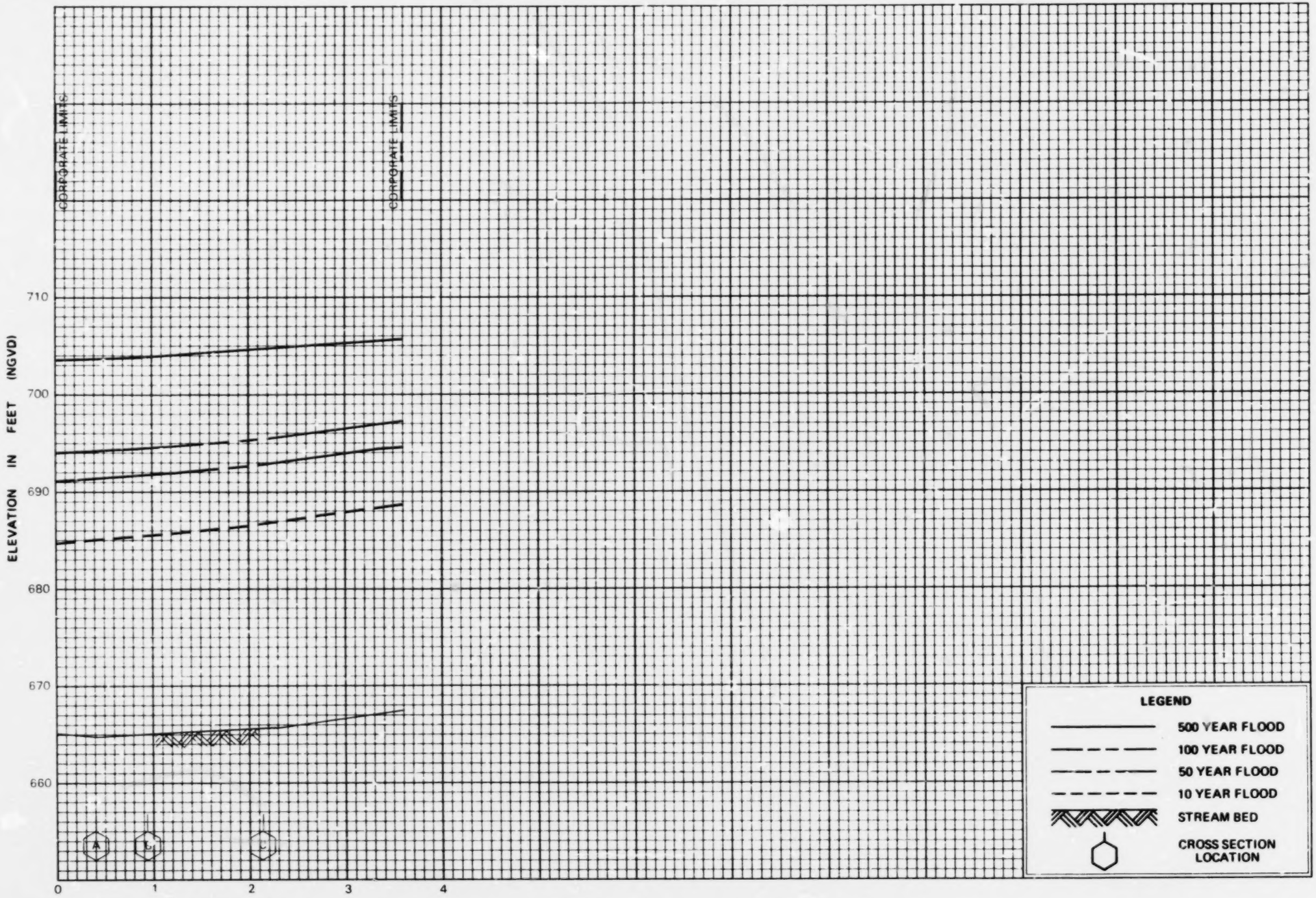
9. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Narrowsburg, Pennsylvania-New York, 1968; White Mills, Pennsylvania, 1967, Photorevised 1983.

10. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Berlin, Wayne County, Pennsylvania, January 10, 1975.

Community Map, General Highway Map, Wayne County, Pennsylvania, prepared by the Pennsylvania Department of Transportation, 1980.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	15	1,050.29	Camp Navajo Road bridge over Indian Orchard Brook. Square cut in top of downstream headwall over center of 6 foot diameter C.M.P.



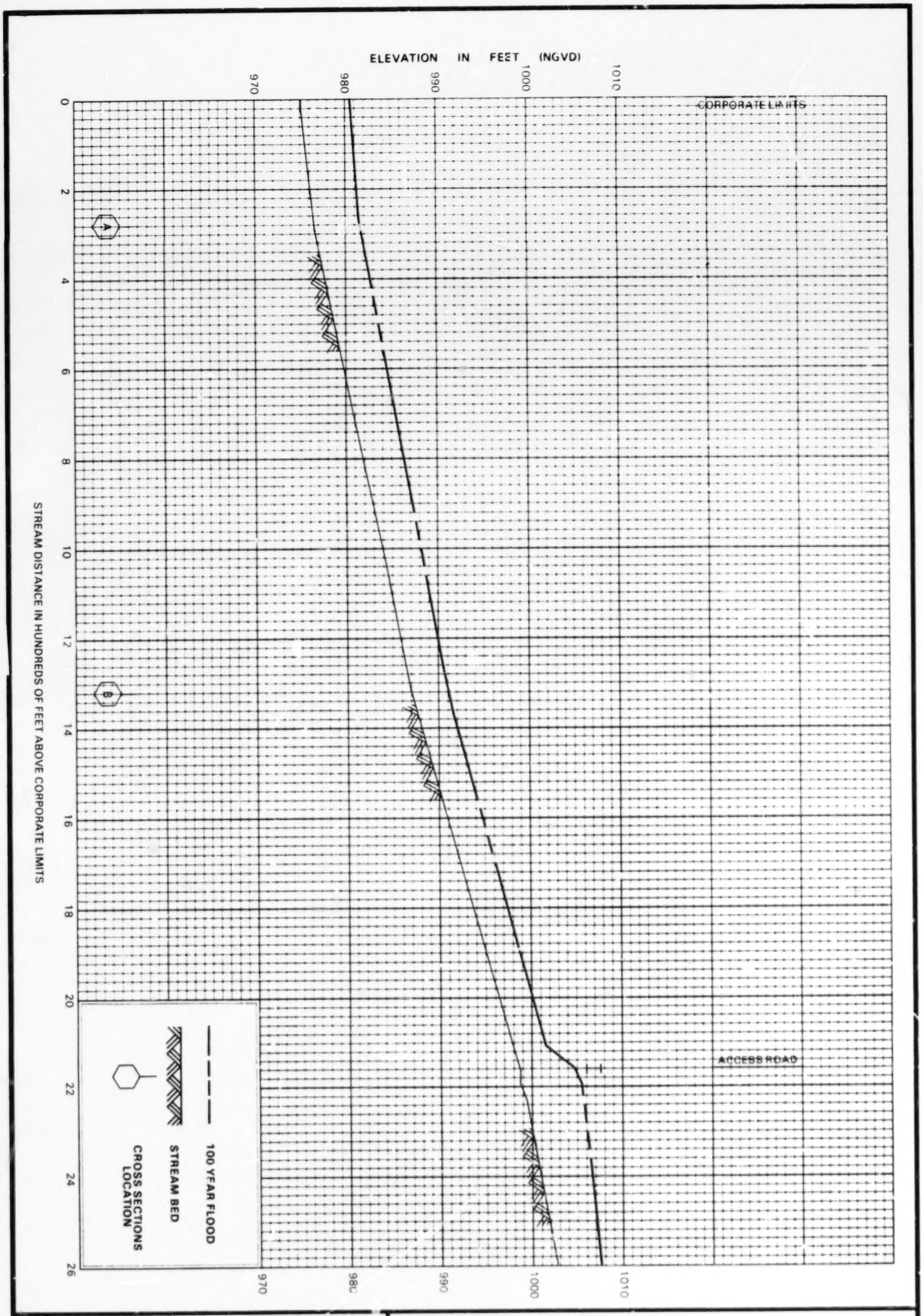
FLOOD PROFILES

DELAWARE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF BERLIN, PA
(WAYNE CO.)

01P



FEDERAL EMERGENCY MANAGEMENT AGENCY

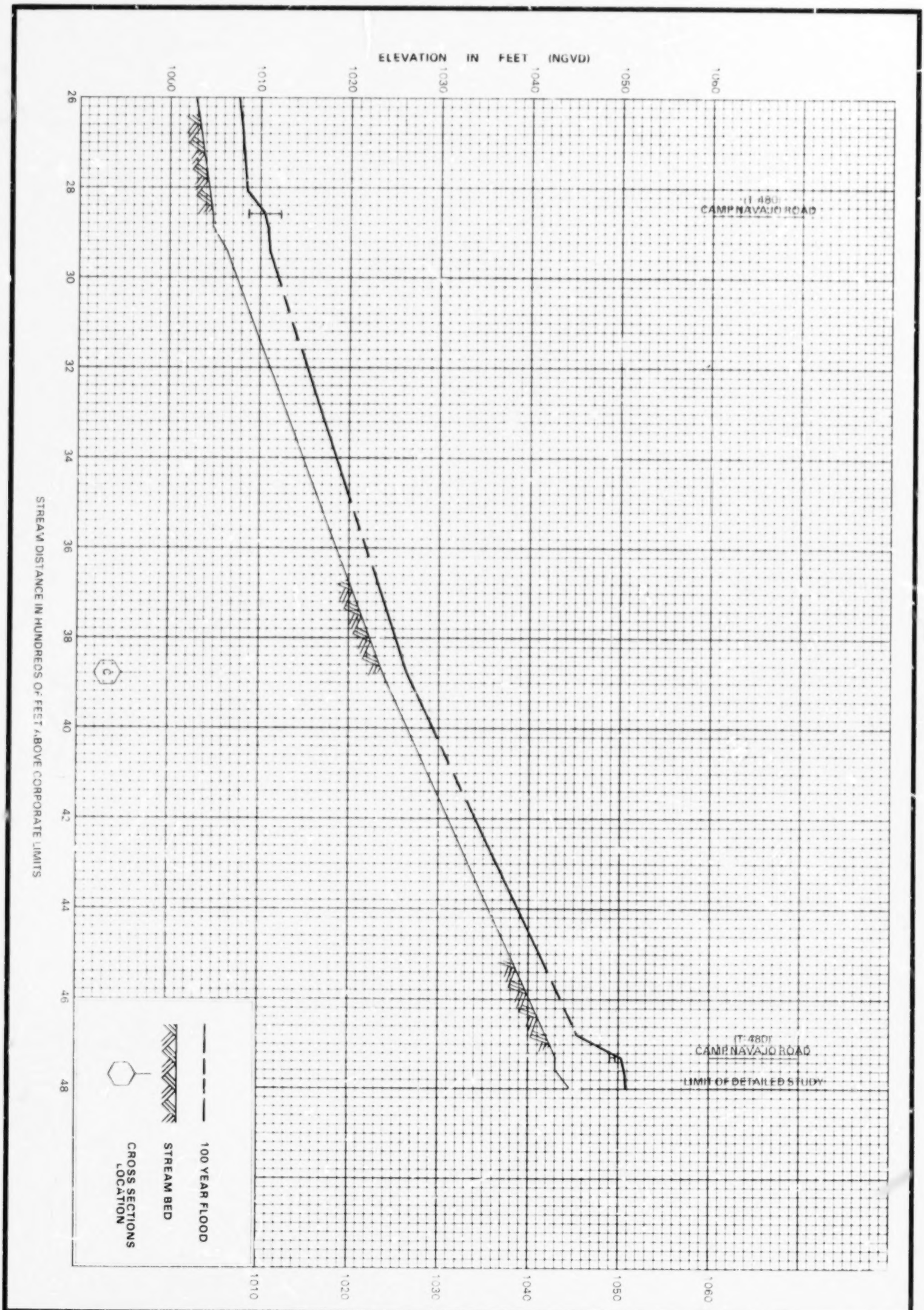
TOWNSHIP OF BERLIN, PA

(WAYNE CO.)

02P

FLOOD PROFILES

INDIAN ORCHARD BROOK



03P	FEDERAL EMERGENCY MANAGEMENT AGENCY TOWNSHIP OF BERLIN, PA (WAYNE CO.)	FLOOD PROFILES INDIAN ORCHARD BROOK